Discrete Shifts Within the Theta Band Between the Frontal and Parietal Regions of the Right Hemisphere and the Experiences of a Sensed Presence

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The attribution of personal cognition to another consciousness or sentient being is strongly correlated with altered perfusion within the frontoparietal or frontotemporal regions. The authors applied weak complex magnetic fields that produce an increased incidence of these experiences in healthy volunteers. Quantitative monopolar electroencephalographic (QEEG) measurements for each of the four lobes of the two hemispheres found that intensity of the sensed presence was significantly correlated with increased power within only the theta range over the right parietal and frontal lobes. Successive 1 Hz incremental analyses indicated specific power increases for 4 Hz–5 Hz and 7 Hz–8 Hz bands over the right parietal and frontal lobes, respectively. These results are consistent with those of other measures for both schizophrenia patients and healthy volunteers; changes in activity within these regions are associated with attribution of one's thoughts and actions to another.

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The sensed presence is the experience of another consciousness or sentient being within close proximity.[1] These phenomena, which involve attribution of personal cognition to another consciousness, are prevalent in all cultures.[2] The sensed presence has been hypothesized to be the transient awareness of the right hemispheric equivalent of the left hemispheric sense of self.[3] In double-blind studies, asymmetric activity within the temporoparietal region—associated with intrinsic stimulation or externally applied, physiologically patterned, weak magnetic fields—has been associated with reports by healthy volunteers of a sensed presence and the feelings that thoughts did not originate from the subject's own mind.[4] Two case reports with patients, each associated with a powerful sensed presence, showed increased perfusion within the frontoparietal or frontotemporal regions.[5,6] These data suggest that the brain correlates of the sensed presence may be similar in healthy and patient populations, and may differ only in subjective intensity, duration, and the degree to which the phenomenology dominates the per-

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son's experiences and beliefs. This would be typical of all behaviors.

Frith[7] and others have suggested that sensing a presence outside of the self, a common correlate of Schneiderian or first-rank positive symptoms of schizophrenia, may arise from misattribution of one's own action or thoughts to an external agent. The cerebral patterns associated with the capacity to discern neurocognitive processes as originating from within rather than outside the self ("ego-alien") involve the frontal-temporoparietal regions.[8] Reduction of the normal coherence between electrical activity between the (self-monitoring) prefrontal lobes and the temporal lobe speech-related areas in schizophrenia patients has been hypothesized as the source of misattribution of self-generated thoughts to an external source.[9] In fact, imaging studies have shown that activation within the inferior parietal lobe resulted in attributing self-action to another.[10,11]

A recent imaging study by Franck et al.[12] showed the severity of first-rank symptoms was correlated positively with rCBF (O-PET) in Brodmann areas 7 and 40 of the parietal cortices. According to Taber and Hurley,[13] these more medially activated areas involved the white matter contributing to the caudal corpus callosum. Alterations in white matter associated with the prefrontal and temporal lobes have been reported in the brains of schizophrenia patients whose symptoms were most severe. Roll et al.[14] found that the cerebral SPECT of Shawn Harribance, a person who has exhibited a lifelong capacity to accurately discern the personal history of others by mechanisms not known to date, displayed increased perfusion within the right medial parietal lobe during the discernment. He attributed the information to "other entities" that he described as "angels." If misattribution of self-generated thoughts are due primarily to anisotropic activity between the inferior parietal and prefrontal regions, then this discrepancy of ongoing function should be evident in healthy volunteers even with the relatively less precise quantitative electroencephalography (QEEG).

METHODS

To test this hypothesis, 12 university students (six men, six women), 20 to 25 years of age, volunteered (with informed consent) as subjects for a relaxation study (no reference to the sensed presence) after a single 5-minute recruitment request within the class. We reasoned that if the effect size between intracerebral increase in electroencephalographic power and the experiences of a sensed presence were either causal or strongly correlated, the association should be statistically significant ($p<0.05$) even with this small sample.

Participants were exposed continuously for 5 minutes each to six successive magnetic field patterns. Between each 5-minute period there was a period of no field for 30 seconds. Six 20-second samples of electroencephalographic paper and electronic records were obtained simultaneously for each participant during the middle of each 5-minute exposure period. During this 30-minute period the subject sat in a comfortable armchair. The hardcopy was employed to verify that the 20-second samples for quantitative analyses were not conspicuously contaminated by movement or machine artifacts. A blindfold and disposable earplugs minimized the effects of ambient stimuli. Monopolar (referenced to ear) recordings were obtained with a Grass model 8–16 machine from the left and right frontal (F7, F8), temporal (T3, T4), parietal (P3, P4) and occipital (O1, O2) positions in accordance with the 10/20 system of electrode placement. The participants were instructed to relax but to avoid drowsiness. Visual assessment of the paper records showed no evidence of Stage II spindles for any of the subjects; all records were also artifact free.

The signals for each 20-second segment were extracted by Labview software with a sampling rate of 1 kHz. In order to obtain the frequencies, fast Fourier analyses software filtered the raw data and generated power spectra for delta (1 Hz–3.9 Hz), theta (4 Hz–7.9 Hz), low alpha (8.0 Hz–10.4 Hz), high alpha (10.5 Hz–13.0 Hz), low beta (13.1 Hz–20 Hz) and gamma (35 Hz–45 Hz). On the basis of our theoretical approach to consciousness[15] as being strongly correlated with second and third derivatives sequestered within narrow bands of theta activity,[16] relative power was also obtained for six successive 1 Hz increments between 4.0 Hz and 9.0 Hz.

During the 30-minute period the six different configurations of weak (1 microT) physiologically patterned (frequency-modulated and burst-firing) magnetic fields were successively generated around (circumcerebral) the head through eight pairs of small solenoids separated by 45 degrees. They were arranged in the horizontal plane just above the ears.[17–19] The counterclockwise and clockwise rotational velocities and derivatives of the change (acceleration) have been described previously[18,19] and primarily involved durations of 10 msec

to 20 msec at the area of stimulation with either accelerations or negative accelerations of +2 or −2 msec. There is no evidence of induction artifacts within the EEG electrodes with these configurations.

These experimental conditions are often associated with the experience of a sensed presence and other mystical states that complement or accompany the attribution of experiences to nonself sources. In addition, our older, qualitative EEG (bipolar) measures have generally shown brief appearances (about 2–10 seconds) of irregular theta activity over the right temporal lobe during these experiences. Subjectively, the "location" is usually attributed to the upper left peripheral visual field for most subjects.

Relative scores for power within each of the different frequency bands and for each of the 1-Hz increments within the theta range were calculated for each of the eight channels for the two hemispheres and four lobes by dividing the activity exhibited during the field presentations by the baseline (no field). In order to discern intracerebral effects (each brain as its control), z scores were calculated by subtracting the raw power during each of the field configurations by the mean of all six configurations and dividing by the standard deviation (SD) for these values.

After the 30-minute exposure, each participant completed a 20-item exit questionnaire[4,20] that reflected the type of experiences often reported in this context. The response (0=never, 1=once, 2=many times) to the item "I experienced a presence" served as the dependent variable. Spearman rho and Pearson r correlations were completed between this response and the z scores and relative scores for power for each of the six lobes and each of the six configurations of magnetic field presentations. Because there was no appreciable difference in the strength of the correlations between the configurations, the relative values and z-scores for the power scores for the six samples recorded for the six configurations were averaged.

RESULTS

The only statistically significant ($p<0.05$) and conspicuous correlation between the reported experience of a sensed presence and electroencephalographic power involved the right parietal and right frontal lobes within the theta band, and not within the delta, alpha, beta, or gamma bands. The Spearman rho values ranged between 0.78 and 0.86. The strength of the correlations for the right temporal lobe within each 1 Hz increments of the theta range was between 0.63 and 0.70, but did not achieve our *a priori* criterion for statistical significance. All other correlations for the other cerebral areas (right occipital, all four left hemispheric measures) were not statistically significant. Specific analyses with each of the 1-Hz increments within the theta range indicated that both relative scores and z scores for power over the right parietal lobe were positively correlated (0.83, 0.77, respectively) with the report of a sensed presence only within the 4.0 Hz to 4.9 Hz increment. On the other hand, the only statistically significant increment associated with the sense of a presence for theta activity over the right prefrontal region was for the 7.0 Hz to 7.9 Hz band for both the relative and z-score measures of power ($\rho=0.77$, $\rho=0.78$, respectively). The effect was conspicuous.

The subjective experiences for those participants who reported a sensed presence were similar to those reported by others exposed to these procedures. The detailed experiences have included feeling another self, sensing a deceased person known to the participant, experiencing a human-like gray face with lights around it (upper left peripheral field), and experiencing "someone" standing nearby.

DISCUSSION

These results are convergent with similar results inferred from several studies using various imaging methods while individuals experienced a sensed presence or the sensation of another proximal sentient being.[21] Our results also support the recent report by Taber and Hurley[13] that activation within the parietal lobe is associated with the attribution of actions to another. In our study the increase in power within the theta range over the right prefrontal and parietal regions was reflected within different discrete frequency bands. Such discrepancies would be consistent with the diminished coherence of the electrical activity within these two regions during attribution of experience to others.

It may be relevant that the "beat frequency," the difference between the two peaks, would be 3 Hz to 4 Hz; this was the dominant paroxysmal discharge over the temporal lobes observed during a powerful experience of "God's presence" by a meditating woman[22] in our

laboratory many years ago. The inference of origin from the montage for this bipolar measurement was the right temporal lobe. A moderate correlation (ρ=0.49) between the amount of theta activity over the temporal lobe and the report of a sensed presence as well as greater right hemisphericity was reported for healthy volunteers (n=26) by Munro and Persinger.[23]

These results are also consistent with the older clinical reports by Slater and Beard,[24] who described a schizophrenia-like psychosis associated with temporal lobe epilepsy where paranoid ideation was dominated by religious themes. Sudden religious conversions and the feeling of powerful presences of God in patients with temporal lobe epilepsy (frequently with right hemispheric foci) were also reported by Dewhurst and Beard.[25] In healthy volunteers (n=28) the numbers of spontaneous spikes over the temporal (bipolar T3, T4) lobes but not over the occipital lobes were moderately (Spearman ρ=0.67; Pearson r=0.76) correlated with psychometric indices of strength of religious beliefs.[26]

The apparent contradiction between temporal lobe versus parietal lobe anomalies as common correlates of the sensed presence or the right hemispheric equivalent to the sense of self[1,20] may reflect the type of misattribution. If the hypoperfusion data of Hillis et al.[27] are generalizable to nonstroke patients, then misattributions that are allocentric (on the left side of individual stimuli, regardless of location with respect to the viewer) would involve the right superior temporal gyrus, while misattributions that are egocentric (the left side of the participant) would involve the right angular gyrus. The subtle distinctions in the complexity of the associated subjective experiences may require more sophisticated psychometric testing. In addition, recent fMRI data have shown that the functional source for the classic left-side neglect associated with right parietal lobe injuries involves the right superior temporal gyrus.[28] This may facilitate the explanation for why the sensed presence can be associated with parietal[21] and temporal lobe[29] anomalies.

It is important to realize that "remembering" or "reiterating" mystical experiences attributed to God or other sources, such as reported by Beauregard and Paquette[30] for Carmelite nuns, should involve different patterns of cerebral activity than spontaneous occurrences. The difference would be comparable to the patterns of activation during the experience of a novel stimulus compared to the later reconstruction (memory) of that experience.[31] There is now epidemiological evidence that the experiences of sensed presence may be facilitated by geophysical transients[32] within many environments; these patterns and hallucinations of "presences" can be reproduced directly within the laboratory by stimulating the right temporoparietal lobes.[33]

One of the limitations of this study was the small sample size. However, the experiences of these participants were similar to those reported in several other experiments,[4,20] some of which were completed under double-blind conditions. In addition, the strongest effect sizes for the association between these experiences and EEG activity involved regions similar to those reported by other experimenters employing different measurements. Although EEG measurements are considered not useful for localization by some researchers, this issue may be less critical if experiences are correlated with electromagnetic matrices involving large cerebral volumes.

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References

1. Persinger MA: The neuropsychiatry of paranormal experiences. J Neuropsychiatry Clin Neurosci 2001; 13:515–524
2. Evans H: Visions, Apparitions, and Alien Visitors. Wellingborough, Northamptonshire, Aquarian Press, 1984
3. Persinger MA: The Neuropsychological Bases of God Beliefs. New York, Praeger, 1987
4. St-Pierre LS, Persinger MA: Experimental facilitation of the sensed presence is predicted by specific patterns of the applied magnetic fields, not by suggestibility: re-analyses of 19 experiments. Int J Neurosci 2006; 116:1079–1096
5. Landtblom AM: The "sensed presence": an epileptic aura with religious overtones. Epilepsy Behav 2006; 9:186–188
6. Newberg AB, Wintering NA, Morgan D, et al: The measurement of regional cerebral blood flow during glossolalia: a preliminary SPECT study. Psychiatry Res Neuroimaging 2006; 148:67–71
7. Frith C: The self in action: lessons from delusions of control. Conscious Cogn 2005; 14:752–770
8. Farrer C, Frith CD: Experiencing oneself versus another person as being the cause of an action: the neural correlates of the experience of agency. Neuroimage 2002; 15:596–603
9. Ford JM, Mathalon DH: Electrophysiological evidence of corollary discharge dysfunction in schizophrenia during talking and thinking. J Psychiatr Res 2004; 38:37–46

10. Farrer C, Franck N, Georgieff N, et al: Modulating the experience of agency: a positron emission study. Neuroimage 2003; 18:324–333
11. Farrer C, Franck N, Frith CD, et al: Neural correlates of action attribution in schizophrenia. Psychiatry Res 2004; 131:31–44
12. Franck N, O'Leary DS, Flaum M, et al: Cerebral blood flow changes associated with Schneiderian first-rank symptoms in schizophrenia. J Neuropsychiatry 2002; 14:277–282
13. Taber KH, Hurley RA: Neuroimaging in schizophrenia: misattributions and religious delusions. J Neuropsychiatry Clin Neurosci 2007; 19:iv–4
14. Roll WG, Persinger MA, Webster DL, et al: Neurobehavioral and neurometabolic (SPECT) correlates of paranormal information: involvement of the right hemisphere and its sensitivity to weak complex magnetic fields. Int J Neurosci 2002; 112:197–214
15. Llinas R, Pare D: Of dreams and wakefulness. Neuroscience 1991; 44:521–535
16. Persinger MA: Is there more than one source for the temporal binding factor human consciousness? Percep Mot Skills 1991; 89:1259–1262
17. Richards MA, Koren SA, Persinger MA: Circumcerebral application of weak complex magnetic fields with derivatives and changes in electroencephalographic power spectra within the theta range: implications for states of consciousness. Percep Mot Skills 2002; 95:671–686
18. Persinger MA, Koren SA, Tsang EW: Enhanced power within a specific band of theta activity in one person while another receives circumcerebral pulsed magnetic fields: a mechanism for cognitive influence at a distance? Percep Mot Skills 2003; 97:877–894
19. Tsang EW, Koren SA, Persinger MA: Power increases within the gamma range over the frontal and occipital regions during acute exposures to cerebrally counterclockwise rotating magnetic fields with specific derivatives of change. Int J Neurosci 2004; 114:1183–1193
20. Persinger MA: The sensed presence within experimental settings: implications for the male and female concept of self. J Psychol 2003; 137:5–16
21. Newberg A, D'Aquili E, Rause V: Why God Won'T Go Away. New York, Random House, 2001
22. Persinger MA: Striking EEG profiles from single episodes of glossolalia and transcendental meditation. Percep Mot Skills 1984; 58:127–133
23. Munro C, Persinger MA: Relative right temporal lobe theta activity correlates with Vingiano's hemispheric quotient and the sensed presence. Percep Mot Skills 1992; 75:899–903
24. Slater E, Beard AW: The schizophrenia-like psychosis of epilepsy I. Br J Psychiatry 1963; 109:95–150
25. Dewhurst K, Beard AW: Sudden religious conversions in temporal lobe epilepsy. Br J Psychiat 1970; 117:495–507
26. Makarec K, Persinger MA: Temporal lobe signs: electroencephalographic validity and enhanced scores in special populations. Percep Mot Skills 1985; 60:831–842
27. Hillis AE, Newhart M, Heidler J, et al: Anatomy of spatial attention: insights from perfusion imaging and hemispatial neglect in stroke. J Neurosci 2005; 25:3161–3167
28. Karnaph HO, Ferber S, Himmelbach M: Spatial awareness is a function of the temporal not the posterior parietal lobe. Nature 2001; 411:950–953
29. Ardila A, Gomez J: Paroxysmal: "feeling of somebody being nearby." Epilepsia 1988; 29:188–189
30. Beauregard M, Paquette V: Neural correlates of a mystical experience in Carmelite nuns. Neurosci Lett 2006; 405:186–190
31. Vandecherkhove MMP, Markowitsch HJ, Mertens M, et al: Bi-hemispheric engagement in the retrieval of autobiographical episodes. Behav Neurol 2005; 16:203–210
32. Suess LAH, Persinger MA: Geophysical variables and behavior: XCVI. "Experiences" attributed to Christ and Mary at Marmora, Ontario, Canada may have been consequences of environmental electromagnetic stimulation: implications for religious movements. Percept Mot Skill 2001; 93:435–450
33. Persinger MA, Tiller SG, Koren SA: Experimental simulation of haunt experience and elicitation of paroxysmal electroencephalographic activity by transcerebral complex magnetic fields: induction of a synthetic ghost? Percept Mot Skills 2000; 90:659–674